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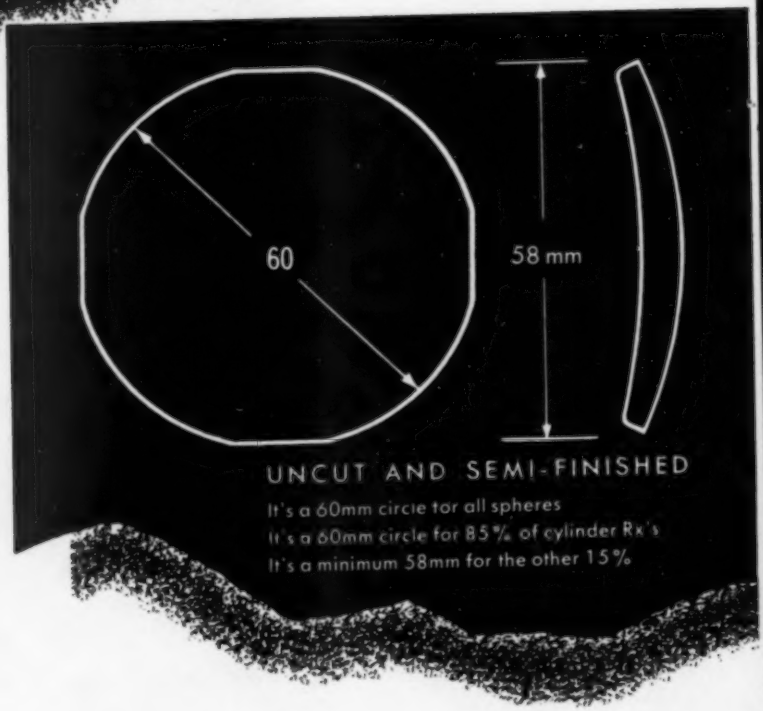
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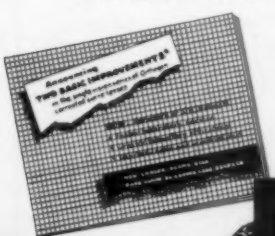

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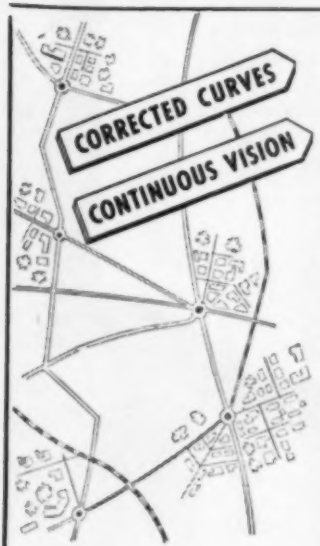

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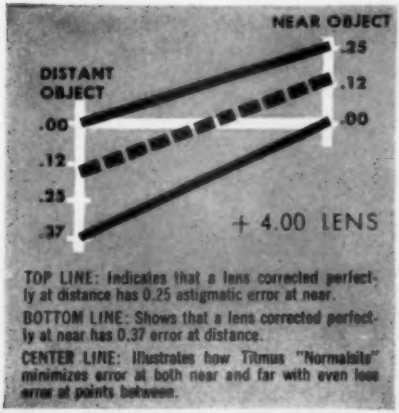

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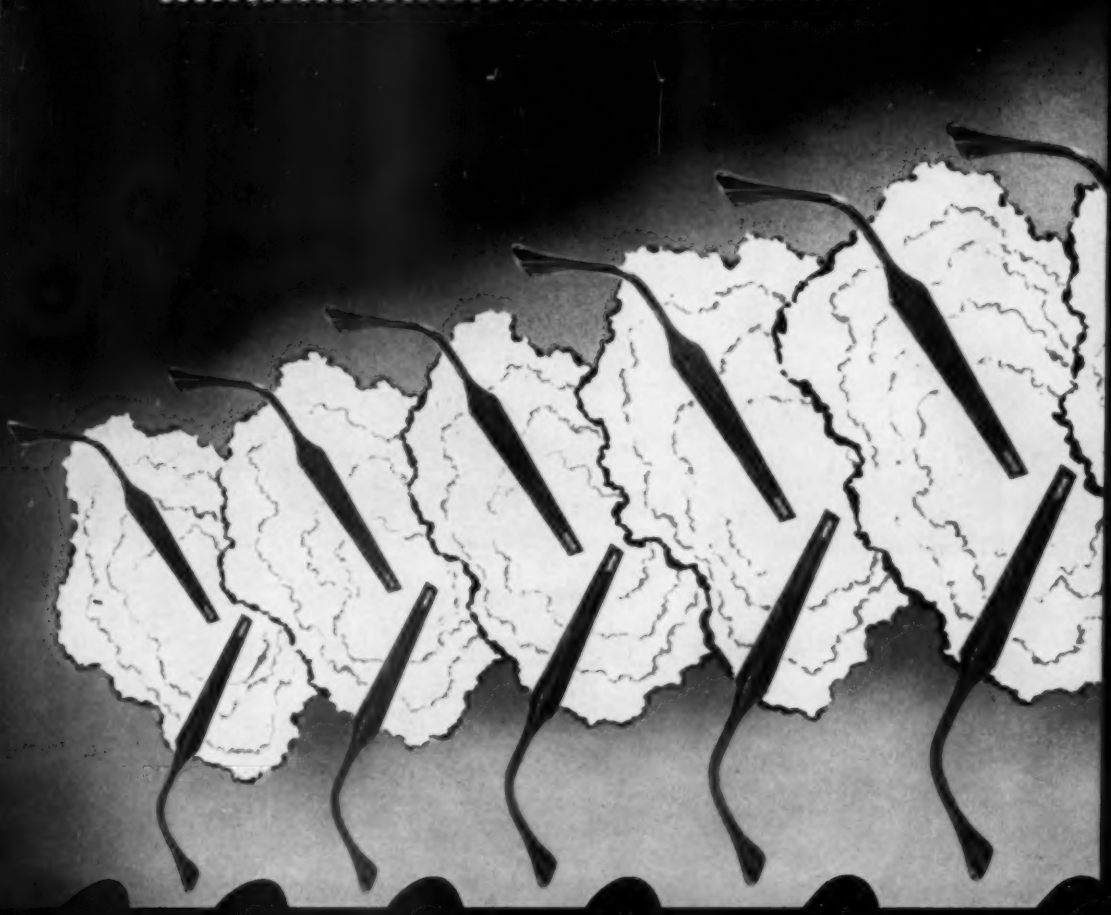

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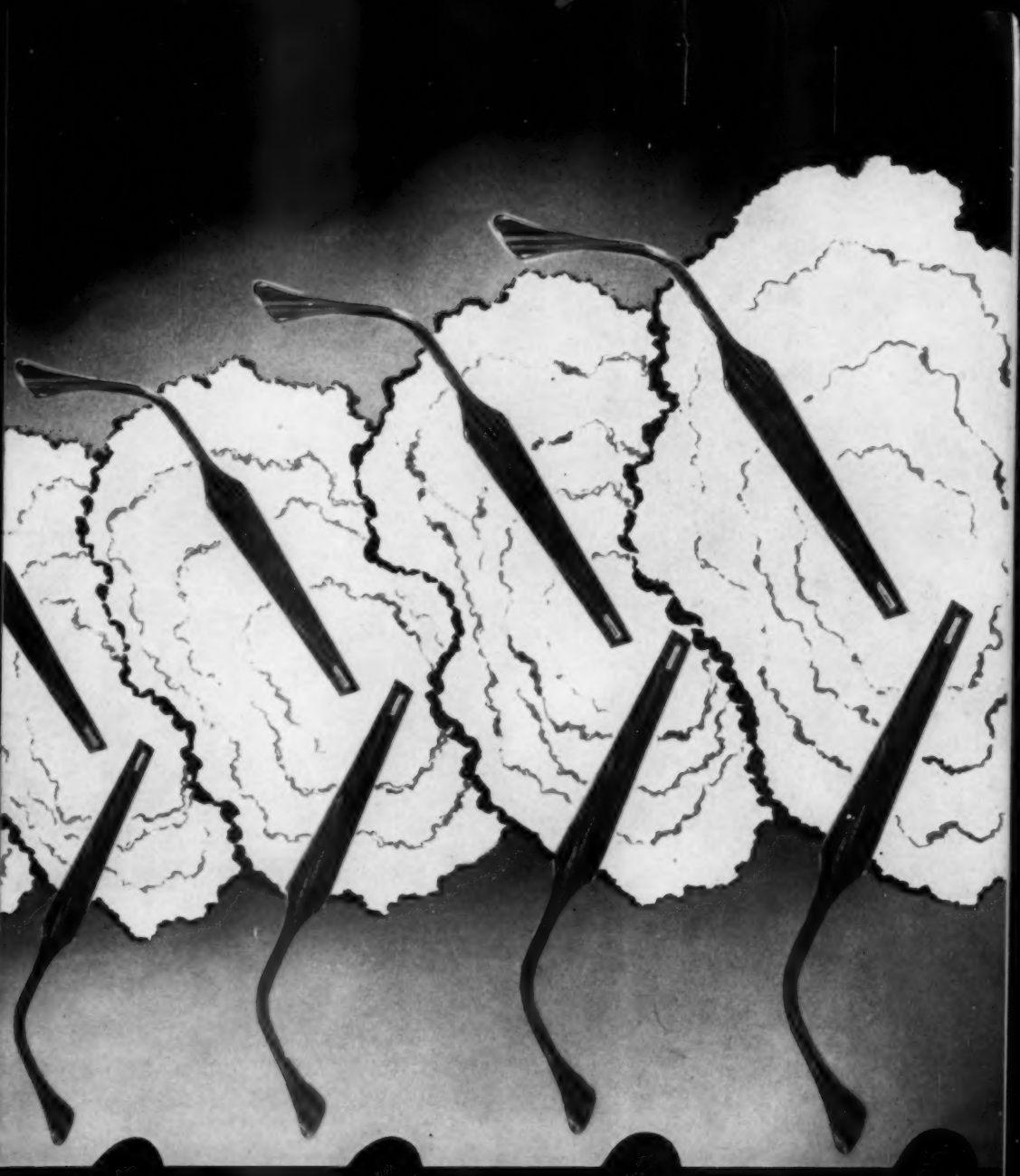

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AMERICAN JOURNAL OF OPTOMETRY
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OBSERVATION IN CLINICAL PRACTICE*

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"Disease leaves its mark upon the look in a man's eye, the mottling of his skin, the swing of his leg, the bend of his back, the heave of his chest."

—L. Clendening

When a new patient presents himself to us for examination we are very likely to automatically note his sex, race, apparent age, constitution, posture, state of nutrition, facies, manner of dress and similar mundane features. The information is sifted and stored in the back of the mind (perhaps to be recalled when the matter of fees comes up) but seldom does it go much further than this. It is precisely these features however, and the clinical deductions to be derived from them which constitutes the subject matter of the present paper.

"You mention your name as if I should recognize it," says Sherlock Holmes to a just announced stranger, "but I assure you that, beyond the obvious facts that you are a bachelor, a solicitor, a Freemason, and an asthmatic, I know nothing whatever about you." The deductions with which Doyle's character amazed his nonplussed side-kick were based on everyday features, visible to anyone who knew how to look. It is both interesting and pertinent that Doyle (who was a physician) based his character on the actual deductive abilities of one of his teachers, Joseph Bell, a great clinician of the 19th century.

That observation is a skill which may be acquired by practice and experience is illustrated by the fact that a currently popular orthoptic technique (i.e. flash perception) is specifically designed to enhance it. Indeed such training may benefit the clinician as well as the patient. The

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The second part of this report, "Nutrition, Posture, Gait, Face and Skin," will appear in the March, 1957, issue. The third and last part, "Hands, Circulation, Nervous and Musculoskeletal Systems," will appear in the April, 1957, issue.
†Optometrist, M.S., Member of faculty, Fellow, American Academy of Optometry.

difference between looking and observing can be nicely brought out by inspecting the wares displayed in a show window for a specified time and then attempting to write down a complete list of the items. This is a useful little game which can be highly recommended to anyone aspiring to be a good observer.

The trained senses can perceive much at a glance but it is useless to look unless one (a) has some notion of what to look for and (b) goes about it systematically. It is nevertheless true that good clinical observation is compatible with incomplete knowledge of pathology and pathogenesis. The descriptive pictures of disease painted by ancient physicians are as true today as they were centuries ago although the theoretical interpretation which was attached to these has changed considerably. Thus clinical observation does not imply a diagnosis but rather serves to arouse suspicion for purposes of further invetigation or referral for such investigation.

Careful patient observation as the patient walks into the office, as he sits at the desk and tells the story of his symptoms and during the remainder of the period of professional contact, will often yield clues as to the presence of ocular or systemic disturbance and especially those eye manifestations which frequently have a systemic cause. Accumulating data on statistical incidence of refractive and allied disorders makes it not uncommonly possible to formulate one's plan of clinical investigation. This is perhaps nowhere more true than when dealing with the increasing proportion of patients in the older age group. Public, state and federal agencies as well as professional groups have studied the problems of the aging population with accelerated interest and concern and a considerable number of professional journals are now devoted to this field (geriatrics and gerontology).

The diversity of the problems and their implications which should come to mind when confronted by an older person (and, for that matter the special problems peculiar to each age group) depend upon an awareness of current literature as regards these, not only in the field of eye care but also in their economic and social ramifications. The point I wish to emphasize is that just as the patient's age (more or less obvious on first inspection) will bring to mind certain problems peculiar to him so will his sex, race, constitution, state of nutrition, posture, etc., focus attention on problems stemming from and peculiar to these characteristics.

No one will deny that the better we know and understand the patient as an individual, the better the care and advice we will be able to afford him. Observation is simply one of the ways of getting to know our patients better.

Careful observation should arouse the optometrist's index of suspicion not only of refractive disorders but of those disturbances requiring medical referral which might have otherwise been missed or overlooked.

AGE

It requires but a glance to determine the patient's race and sex. More careful observation may be necessary to obtain an accurate estimate of his age. It may be useful to compare the patient's apparent age to his stated age and consider the question of why a particular individual looks (or acts) older (or younger) than his chronologic age.

In a previous paper we pointed out that certain visual problems are more or less peculiar to various age groups because people change in their structural and functional make up as they grow older. Thus there are texts devoted to diseases of children's eyes, diseases of mature eyes while others have devoted their attention to disturbances peculiar to the vision of the school population and the aged. It is superfluous to point out that these widely different groups require different investigative methods but it may not be amiss to emphasize that they also deserve specialized diagnostic thinking.

The implications of a given patient's age may be conveniently categorized as anatomical, physiological, psychological, pathological and clinical. Such a classification is rather arbitrary since growth is a continuum and the process of ageing a complex integrated affair. One should also appreciate that the various categories mutually influence each other so that, for example, anatomic and physiologic variation predisposes to certain pathologic changes which manifest themselves as clinical disturbances. For purposes of orientation these rather general aspects of development and ageing are summarized in Table I.

TABLE I

Some general ocular implications of the patient's age

I. Anatomical
1. Changes in volume, diameter and circumference of the eye and its individual optical components.
2. Variations in development of myelin, pigment, elasticity and rigidity of ocular tissues.
3. Development, maturity and degeneration of macula and fovea.
4. Changes in mensuration of orbit and ocular adnexa.
5. Development of neurologic pathways associated with visual apparatus.

II. Physiological
1. Development of protective reflexes and tear secretion.
2. Development of binocular motor coordination.
3. Development of fusion and color discrimination.
4. Development and decline of accommodative mechanism.
5. Development and decline of visual acuity.

III. Psychological
1. Development of integration of vision with language and personal-social development.

Continued

2. Development of eye-hand coordination.
3. Variations in visual perception of light, form and color.
4. Implications of psychologic disturbances on visual function.
5. Implications of intelligence, motivation and emotional status for therapy.

IV. *Pathological*
1. Congenital and hereditary disturbances.
2. Disturbances associated with metabolic, endocrine and reproductive changes.
3. Degenerative and retrograde anomalies.
4. Disturbances associated with bacteriologic, physical and chemical trauma.
5. Neoplastic diseases.

V. *Clinical*
1. Age differences of refractive disorders and rate of change of refractive errors.
2. Age differences of binocular motor anomalies.
3. Age differences of ocular disease processes.
4. Implications of above for prevention and screening.
5. Implications of above for treatment, prognosis and progress report visits.

Given a patient of a particular age what refractive disorder is he likely to have? The following table from Tassman (1932) may be found helpful in answering this question. (Table II).

TABLE II

Incidence of ametropia at various ages. (After Tassman, 1932.)
Spherical refraction 18,340 eyes

		0.50 or less		*Hyperopia*		*Myopia*	
Age	*No. Cases*	*Eyes*	*%*	*Eyes*	*%*	*Eyes*	*%*
Under 5	406	10	1.2	794	97.8	8	1.0
5-10	855	74	4.3	1488	87.1	148	8.6
10-15	1031	210	10.1	1449	70.4	403	19.5
15-20	853	206	12.1	1079	63.2	421	24.7
20-30	1378	414	15.0	1736	63.0	606	22.0
30-40	1404	373	13.4	1996	71.0	439	15.6
40-50	1538	549	17.9	2081	67.7	446	14.4
50-60	988	336	17.1	1317	66.6	323	16.3
60-70	552	130	11.8	775	70.2	199	18.0
Over 70	165	30	9.1	231	70.0	69	20.9
	9170	2332		12,946		3062	

The data indicate, in conformity with most other observers, a decrease in hyperopia and an increase in myopia with age up to about middle life when there is a period of stability followed by secondary changes after the age of 50 or 60 years. Unlike some other investigators, Tassman's results do not show the slight increase in hyperopia up to age 5 or 6 years.

While these and similar studies are of great theoretical interest with respect to the question of the mechanisms producing these changes, a matter of more immediate clinical importance is the *rate of refractive change* with age. What predictions can we make regarding the refractive status 5, 10 or 20 years hence? It is at once apparent that such changes are more dramatic in the younger and probably in the older population than in the intermediate group. This is indicated in the following results obtained by Brown (1938) and more recently by Walton

(1950), Hofstetter (1954) and Hirsch (1952). (Table III). The rate of change is especially great during the period of adolescence. The implications of such information for treatment, prognosis and scheduling of return visits should be obvious.

TABLE III

Net yearly changes in refractive error. (After Brown, 1938.)

Age	*Computations*	*Change-yearly Average*	*Type**
1-7	1668	0.18 D.	D
8-13	2862	0.23 D.	I
14-20	2068	0.14 D.	I
21-33	1687	0.04 D.	I
34-42	441	0.03 D.	D
43-51	94	0.03 D.	I
Birth-51	8820	0.09 D.	I

* D = Decrease; I = Increase

Various studies have been carried out relating age to various visual functions. Data on visual acuity are controversial but the concensus is that there is a slight but definite decrease with age. Luckiesh and Moss, 1937.

As is well known, the amplitude of accommodation decreases gradually with age and provides a rough (but often inaccurate) estimate of the needed presbyopic add. The ACA ratio appears to remain more or less constant through the years. Changes in accommodative convergence as clinically measured with age are shown in Table IV.

TABLE IV

VALUES OF ACCOMMODATIVE CONVERGENCE IN 3,900 OCULARLY COMFORTABLE SUBJECTS IN FOUR AGE GROUPS*

Accommodative Convergence	10-19	20-39	40-59	60 & Over
0Δ	0	5	25	12
1Δ	0	4	13	8
2Δ	1	3	31	20
3Δ	2	4	31	23
4Δ	2	8	65	32
5Δ	1	14	56	21
6Δ	5	23	108	56
7Δ	7	22	87	45
8Δ	15	42	125	39
9Δ	15	33	126	35
10Δ	25	118	241	91
11Δ	30	75	119	30
12Δ	83	162	199	65
13Δ	50	118	109	32
14Δ	86	161	105	23
15Δ	54	102	49	10
16Δ	54	89	36	10
17Δ	35	53	8	2
18Δ	31	40	8	5
19Δ	8	25	8	0
20Δ	19	27	2	2
21Δ	19	14	2	0

Continued

22Δ	24	15	6	2
23Δ	7	7	2	0
24Δ	10	9	0	0
25Δ	3	1	0	0
26Δ	6	1	2	0
27Δ	2	0	0	0
28Δ	0	3	1	0
29Δ	0	1	0	0
30Δ	2	2	0	0
Total No. of Cases	592	1,181	1,564	563

(Years)	(No. Subjects)
10 to 19	592
20 to 39	1,181
40 to 59	1,564
60 and over	563

After Tait, (1951).

With respect to lateral phoria there is a tendency to esophoria at far point and exophoria at near point with increased age. Progressive lenticular changes account for the gradual slight increase in against-the-rule astigmatism (Table V). The pupillary reactions tend to become more sluggish and the average pupil size smaller with advancing age. The elasticity of the lids decreases and senile degenerative changes occur in the fundus.

TABLE V

Changes in astigmatism with age

0 - 30 years, 0.25 D.: 30 - 60 years, 0.50 D.: Over 60 years, 0.75 D.

CORNEAL CHANGES	LENTICULAR CHANGES	RETINAL CHANGES
1. Hereditary or arises early in life.	1. Changes especially marked in later life.	1. Probably no change with age.
2. Changes may occur throughout life.	2. Usually regular against-the-rule.	2. Mechanism not yet established.
3. Usually regular with-the-rule.	3. Average changes listed above.	3. Irregular.

Anomalies and diseases of the eye also tend to have an age preference, that is they are more common at some ages than at others. Thus certain disorders tend to be found in premature infants (e.g., retrolental fibroplasia) while others occur in the older patient (e.g., arteriosclerotic retinopathy). Now it is quite true that the optometrist will not likely be confronted with a premature infant in his office but he may see the patient 20 or 40 years later and the knowledge of premature birth will make him better able to evaluate the residual (permanent) complications of the disease which was active many years before. In general, if we know what disturbances are likely to occur at a particular age, we will be more alert to search for these particular abnormalities and less likely to overlook them. Some of the ocular disturbances more or less peculiar to various age periods are summarized in Table VI.

SEX

If one discounts diseases of the genital tract proper, the male is in

TABLE VI

I. DISTURBANCES ASSOCIATED WITH PREMATURITY
1. Congenital and hereditary anomalies
2. Birth trauma, anoxia, infection
3. Retrolental fibroplasia
4. Retarded central vision
5. Strabismus

II. DISTURBANCES ASSOCIATED WITH NEONATAL PERIOD
1. Congenital and hereditary anomalies
2. Birth trauma, anoxia, infection
3. Infections transmitted from mother (syphilis, gonorrhea, rubella)
4. Inclusion conjunctivitis
5. Anomalies of motor functions of eye

III. DISTURBANCES ASSOCIATED WITH CHILDHOOD AND ADOLESCENCE
1. Ocular injuries and accidents
2. Concomitant strabismus
3. Myopia and pseudomyopia
4. Retinoblastoma and glioma
5. Blepharitis marginalis
6. Sinusitis and orbital cellulitis
7. Ocular effects of childhood infectious diseases
8. Hordeolum
9. Infantile cataract
10. Juvenile diabetes
11. Foreign bodies
12. Vernal conjunctivitis
13. Craniopharyngioma
14. Congenital interstitial keratitis

IV. DISTURBANCES ASSOCIATED WITH ADULTHOOD
1. Chronic catarrhal conjunctivitis
2. Glaucoma
3. Hypertensive retinopathy
4. Chalazion
5. Grave's disease
6. Toxemia of pregnancy
7. Meningioma
8. Bell's palsy
9. Episcleritis
10. Multiple sclerosis
11. Tuberculous uveitis
12. Superficial punctate keratitis

V. DISTURBANCES ASSOCIATED WITH SENILITY
1. Presbyopia
2. Cataract
3. Arteriosclerosis
4. Fundus degenerations
5. Diabetic retinopathy
6. Senile ectropion
7. Pterygium
8. Arcus senilis
9. Asteroid hyalitis
10. Retinal detachment
11. Keratoconjunctivitis sicca
12. Mooren's ulcer

general more susceptible to disease than the female and he is likely to die at an earlier age. Sex-linked hereditary disorders such as color blindness and hemophilia are much more likely to affect males than females. Migraine, glaucoma, hyperthyroidism and high myopia are somewhat more common among females. With respect to the last point the studies of Hirsch (1953) indicate that of 5201 randomly selected patients ranging in age between 18 and 50, there are more than twice as many women having myopia over 6.00 D. than men while amongst myopes of lower degree the ratio is 4 to 5. There is some indication that there are different types of myopia on the basis of their statistical distribution and it may be that there is a sex factor involved in these types (Hirsch, 1950).

A recent study has shown a "highly significant difference between the sexes in judgment of distances, men exhibiting superior performance" (Oliver & Lauer, 1956).

The female is subject to the influences of menses, pregnancy and menopause upon visual function. Of these the most important are the

toxemias of pregnancy (preeclampsia and eclampsia). Some ocular implications of pregnancy are give in Table VII.

TABLE VII

Some ocular changes which may occur in the course of pregnancy.

Effects on the fetus.
1. Infection. (e.g., rubella, syphilis, gonorrhea).
2. Birth injuries. (e.g., retinal hemorrhages, corneal injuries).
3. Anoxia.
4. Prematurity.
5. Endocrine and metabolic disorders.

Effects on the mother. Uneventful pregnancy.
1. Increased pigmentation of skin of lids.
2. Transient changes in intra-ocular tension.
3. Transient visual field changes.
4. Slight blurring of optic disc.
5. Occasional transient refractive changes.

Effects on the mother. Toxemias of pregnancy.
1. Photopsiae.
2. Headache.
3. Lid edema.
4. Attenuation of retinal arterioles
5. Local variations in vessel caliber.
6. Retinal hemorrhages and exudates.
7. Papilledema.
8. Retinal detachment.
9. Retinal edema.
10. Transient amaurosis.

Swelling of the eyelids, burning and smarting and mild photophobia is an ocular syndrome which may accompany the menopause (Hickey, 1951). The variety of symptoms of which 10% to 15% of women of this group complain may bring them to the vision specialist for evaluation of headache, migraine, exophthalmos, etc. The effects of menses has been investigated by Bergin (1952) who could demonstrate no consistent effects upon refractive error. Evans (1941) on the other hand believes a distinctive ceco-central scotoma to accompany menstruation and refers to it as the "scotoma of menstruation." Dermatologic and psychologic effects are not uncommon in the post-menopausal period.

Anatomical sex differences, e.g., the prominence of the supraorbital ridges and shape of the orbit as well as differences in temperament must be considered in the selection of suitable spectacle frames. The female is also subject to the allergic and contact dermatoses consequent to the use of cosmetic preparations.

The male, generally being the provider for the family, will be subject to occupational and other eye hazards different in quality and quantity than those confronting his spouse. Some ocular implications of patient's sex are summarized in Table VIII.

TABLE VIII

Some ocular implications of patient's sex

1. *Anatomic:* Variations in size and dimensions of orbit, facial and skull structure.
2. *Physiologic:* Effects of menstruation, pregnancy, menopause and post-menopause.
3. *Psychologic:* Variations in temperament.
4. *Pathologic:* Variations in sex-linked hereditary disorders; atherosclerosis, glaucoma, migraine, myopia, etc.
5. *Environmental:* Occupational eye hazards, cosmetics.

RACE AND ETHNIC GROUPS

It is well known that different individuals of the same species vary in their sensitivity to disease, in their somatic and functional reactions to it and in the degree of compensation and recuperation. Some of these variations are understood but many remain unexplained in terms of vague hereditary, racial, constitutional and focal deficiencies or inefficiencies. The Negro for example is said to be less resistant to tuberculosis and responds more favorably to anti-gonorrhea therapy than the Caucasian. Measles has been the scourge of several primitive peoples while having a relatively mild effect on civilized man. Certain diseases (e.g., Tay-Sachs, Buerger's and Diabetes) are said to be more common among Jews than non-Jews. The exact role of race as compared to environmental differences imposed by socio-economic and geographic pressures remains to be determined. Thus it has been shown that certain characteristics (e.g., blood types) show greater similarity among widely different groups in the same geographic area than similar groups from differing geographic and climactic areas. The question has some theoretical as well as clinical interest. Thus it is generally held that myopia is more common in the Orient and much speculation has been attached to the reason and significance of this observation. Studies comparing the incidence of refractive error in civilized and so-called "uncivilized" groups would, it was hoped, throw some light on the etiology of ametropia. Unfortunately none of these investigations has proved of any conclusive value.

A number of studies have demonstrated that myopia is more frequent in Europeans than Americans and this observation has recently been confirmed by Nadell & Hirsch (1955) though the differences are by no means impressive.

There is a peculiar but interesting differential response of Caucasian, Mongolian and Negro to ephedrine (Drill, 1954).

CONSTITUTION

Certainly one of the most obvious things to be noted about a patient is his general body build. But constitution implies more than this. It represents a basic set of physiologic as well as anatomic characteristics predetermined by heredity and modified by environment.

Much has been written about constitutional factors in disease especially by the older clinicians who tended to attribute more importance to it than we are inclined to at present.

Numerous attempts to classify people into "constitutional types" have met with almost universal disagreement. One of the simplest of these is the sthenic-asthenic dichotomy. Its implications are nicely summarized by Boyd (1947):

> "The *sthenic* individual is short and stout, with a wide costal angle and deep chest, inclined to be florid, of cheerful sanguine disposition, liable to gall-bladder disease, arterial hypertension and likely to die of arteriosclerosis, apoplexy or coronary occlusion owing to defects in his germ plasma at the time of conception. The *asthenic* individual is tall and thin, with a narrow costal angle, a pallid countenance, easily fatigued and inclined to be melancholy; he has a long, drooping stomach which empties poorly and intestines which sag, so that his melancholy may be aggravated by dyspepsia and constipation. He is a likely subject for peptic ulcer. He seldom has heart or arterial disease and is likely to be long-lived if he escapes tuberculosis in youth. The gall-stone man seldom has ulcer; the ulcer man seldom has gall-stones. The pages of Shakespeare and Dickins are filled with immortal characterizations of these types."

What role does constitution play in the etiology of visual problems? Relatively little data are available on this point. Johansen (1951) for example has attempted to relate myopia to physical height and weight but no such relationship could be confirmed by Young (1951). Johansen studied 527 boys ranging in age from 12 to 15 from Danish schools. Routine school examination revealed 84 of these to have reduced acuity, 43 of whom proved to have myopia ranging from 0.50 to 7.00 diopters (average 2.6 D.). A hereditary predisposition could be established in 50% of the cases. A correlation between the ametropia and height and weight showed considerable relation to height but not weight: a quantitative correlation between physical measurements and the degree of myopia was not demonstrated. Johansen suggests that the development of myopia be considered as a link in a general growth anomaly within the range of normal variation, a causal combination determined mainly by hereditary but possibly also exogenous factors. Gardiner (1954) found that boys 6 to 14 years of age who are myopic are usually 10 pounds heavier and 1.5 inches taller at their mean age. Girls were less apt to show this until they reached the menarche when they also go ahead of the mean.

The suggestion that head size or some derivative thereof (e.g., the cephalic index) is related to ametropia has been suggested (e.g., Zoethout). The rationalé that myopia is more common in brachycephalic heads (cephalic index greater than 80) is probably related to interpupillary distance. Vandegrift (1924) studied 440 patients, half of whom were myopes, the other hyperopes. Of the 220 myopes he found 178 to be brachycephalic; of the 220 hyperopes he found 193 to be dolichocephalic. The others were classified as dolicho- and brachycephalic

respectively. There were apparently no normal (i.e., mesocephalic) heads in his entire group. As might be expected the interpupillary distance was considerably greater in the myopic brachycephalics (64.25 mm.) than in the hyperopic dolichocephalics (58.50 mm.). Vandegrift concludes that myopia, while hereditary, is a growth reaction, similar in etiology to growth reactions and probably endocrine in origin.

One of my former students (Shreve) has attempted to verify these observations. He measured the cephalic index of 50 college students and obtained the results shows in Table IX. It will be seen that these results do not agree with the conclusions of previous investigators. Young (1951) also tested the hypothesis that broadness of face is a contributory factor in the pathogenesis of myopia but found no significant correlation. There is thus little to indicate that cephalic index is of much diagnostic importance except perhaps in estimating the fit of a spectacle frame.

TABLE IX

Relation of Cephalic Index to Ametropia. N = 50.

Dolichocephalic	Mesocephalic	Brachycephalic
46% of population	42% of population.	12% of population
(CI = 70 — 75)	(CI = 75 — 80)	(CI = 80 — 85)
Hyperopia 28%	Hyperopia 22%	Hyperopia 10%
Myopia 14%	Myopia 18%	Myopia 2%
Emetropia 4%	Emmetropia 2%	Emmetropia 0%

More interesting from a clinical as well as theoretical view are studies of the visual characteristics of siblings especially twins. Thus, if for a given trait, uniovular twins differ less than binovular twins it supports a hereditary basis for the trait while if the differences are similar it may be inferred that the trait is predominantly environmental. Waardenburg (1950) has recently summarized the literature with respect to such twin studies in all phases of ophthalmology. Both normal and abnormal ocular traits are reviewed. With respect to refraction he finds data exist on about 300 pairs of monozygotic twins and about 225 pairs of dizygotic twins. Excluding high degrees of myopia which he attributes to degenerative changes (and in which large differences may be found in the two eyes of the same individual) he finds that for monozygotes 90% show differences less than 1.00 D. and 74% less than 0.50 D. The total range of differences as well as individual differences were much larger for dizygotic twins. "All this evidence," writes Waardenburg, "points in one direction, namely that refraction and errors of refraction have a hereditary basis. Myopia found in school children and others engaged in close work has exactly the same basis. The most valuable result of twin research in refraction is, that it has done so much to supplant the idea of myopia as an occupational dis-

ease." Especially interesting in this regard is the qualitative study of Jancke and Holste (1951) who noted that monozygotic twins still had similar refractions even when one was doing strenous close work and the other was not. Hofstetter and Rife (1953) found a marked correlation among identical twins and a lesser correlation among fraternals with respect to mean spherical refractive error. They studied 27 pairs of identical and 12 pairs of fraternal twins with respect to a number of factors usually obtained in optometric examinations. It is interesting that they found no correlation with respect to corneal or total astigmatism in contrast to Waardenburg's conclusions (though the latter agrees that variability is greater than for spherical refraction). With respect to other measured variables Hofstetter and Rife conclude that "none of the optometrically determined traits considered in this survey would serve to identify the type of twinship. Conversely, the awareness of twinship, either fraternal or identical, would not enable clinically useful predictions to be made from one twin to the other." In a separate, more rigorously controlled study, Hofstetter (1948) found variation in ACA ratio to be significantly less in identical twins (30 pairs) than between pairs or families. He concludes that "the high similarity points either to the inference that there is a genetic basis for accommodative convergence or that the environmental factors influencing the development of accommodative convergence are remarkably selectively similar for the two members of each pair."

General conclusions from twin studies with respect to binocular anomalies, especially strabismus, are not warranted since the exact classification and etiology of the conditions are often not specified.*

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*Part two of this report, "Nutrition, Posture, Gait, Face and Skin," will appear in the March issue.

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AMERICAN ACADEMY OF OPTOMETRY

REPORT FROM THE BRITISH CHAPTER

The British Chapter, American Academy of Optometry, held a scientific meeting in December at the headquarters of the British Optical Association in London. The guest speaker was Mr. H. B. Marton, senior lecturer in the optometry department of the Manchester College of Technology, one of the most erudite and most respected figures in British optometry.

The subject on this occasion was "Sight & Brain," in which he covered the development of the brain from the neural groove of the embryo to the final adult form, the anatomy of the optic tract, recent research on the optic chiasma, the electrical nature of the nervous impulse set up during the act of vision, particularly the alpha rhythm, and the problem of visual memory.

In the absence of the president, Mr. A. E. Turville, who was lecturing at an optimetrists' refresher course, the chair was taken by Mr. Harry Freeman. Guests present included German and Swiss optometrists who were spending a few weeks in Mr. Freeman's practice to gain experience in British methods of refraction. The vote of thanks at the end of Mr. Marton's lecture was moved by Mr. C. S. Flick, chairman of the British Optical Association, London Local Association. Mr. Eric Bateman, the Chapter secretary, announced that it is hoped to make up a party of A.A.O. members to attend the International Optical Congress in Amsterdam in June, 1957. He will be glad to hear of any American optimetrists who are likely to be visiting Europe at that time.

C. S. FLICK

VISION AND RAPID READING*

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INTRODUCTION

Within the past few years numerous reports have appeared describing the phenomenally high speeds achieved by students of speed reading training programs. Reading rates ranging from 2,000 to 8,000 words per minute are often reported. One newspaper article told of an individual reading at 30,000 words per minute. Information of this nature is being disseminated by various journals, magazines, brochures and circulars, with radio and television joining the chorus.

We often hear people speak of other reading feats, these being performed by mental giants, who are capable of reading a page at a glance and those, with a more "limited span," grasp complete paragraphs with a single fixation.

Since these reports are being circulated, it would seem desirable to conduct scientific inquiry concerning their validity.

HISTORICAL

In 1878, Javal,[1] made a most significant discovery by simply watching the eye of a school child who was reading. His very eminent predecessors had assumed the truth of the common belief of "sweeping the eyes along a line of print." He found, not a steady sweep, but a series of little jumps (saccadic movements) with intervening fixation pauses.

It then became important to know whether we see during saccadic eye movements. Subsequent investigation revealed that only blurs and streaks are observed during version movements. Under various environmental seeing conditions and in reading these blurs and streaks are extremely brief due to the speed of the saccadic movement (from 1/25 to 1/50 of a second in reading) and very faint due to minimal brightness contrasts which normally prevail. Consequently, being of no practical value or interest, they are habitually disregarded and ignored.[2]

PERIPHERAL VISUAL ACUITY AND MASKING

In a study of peripheral visual acuity, Feinberg[3] (Table I) found the following values:

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*Read before the annual meeting of the American Academy of Optometry, Houston, Texas, December 11, 1956. For publication in the February, 1957, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.

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TABLE I
PERIPHERAL VISUAL ACUITY

Distance from Fovea	Visual Acuity
1°	20/30
2°	20/35
3°	20/50
4°	20/60
5°	20/70

In an earlier experiment Wertheim[4] determined a peripheral visual acuity curve which closely corresponds to the above figures. Acuity measurements made by Weymouth[5] and co-workers from 1.5 degrees to fixation also approximates the data obtained by Feinberg.

The letters in most printed material subtend an angle equivalent to a 20/60 letter (1.76 mm. at 16 inches). Thus on the basis of the above peripheral acuity figures, an individual would be able to identify two 20/60 letters separated by 2.2 inches with a single fixation provided he was fixating midway between standard block letters as follows:

E • H

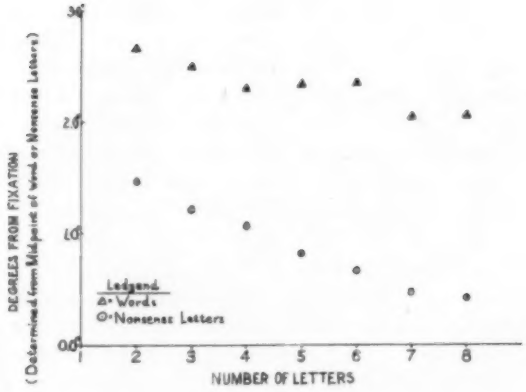
2.2 inches

Peripheral visual acuity provides adequate vision 1.1 inch on either side of the fixation point, located 16 inches from the eyes.

Ruediger[6] presented tachistoscopically to his observers a white card on which was printed an "N" or a "U" at varying distances from a central fixation point. The card was 30 centimeters from the reader's eye. It was found that indirect vision was still satisfactory for perception of 11 point type when the letter was 2½ centimeters on either side of the central point.

Theoretically it would seem possible to span an entire line of 2.2 inches of standard block letters with a single fixation if fixating centrally. Yet, an eye movement is necessary before grasping the span. This is due to mutual interference or masking of the letters in indirect vision, as explained below.

Korte[7] (Graph I) studied letters, words and nonsense syllables in indirect vision, recording the eccentricity measured as a tangent. The words, composed of German lower case letters, ranged from 2 to 8 letters and were read at a distance of 30 cm. He found that a group of letters, in comparison with a single letter, must be brought closer to the fixation point in order to be read. As would be anticipated on the basis of peripheral visual acuity, he found that capitals were read further out than the lower case letters. Korte also determined that isolated letters were read further out than words, and the longer a word, the closer it must be brought to the fixation point.



Graph 1.

The anatomical arrangement of the retina provides the basis for the explanation. The fovea centralis according to Polyak[8] subtends an angle 1°40′ at the nodal point of the eye. At the fovea each cone is thinner and connected to only one ganglion cell. Its impulse is therefore much purer, and the image received by the brain much sharper than elsewhere in the retina, being as it were insulated from the impulses of neighboring cells. In the retina generally each visual cell is in relation with many, up to 100, ganglion cells.[9]

Printers rarely use standard block form but usually some modification such as condensed, extra condensed, etc. Thus a 20/60 letter, 1.76 mm. vertically is usually 20/40, 1.17 mm., horizontally. This reduces the visual angle subtended to 2½° on each side of the fixation point or a total span of 1.4 inch. This span is further reduced by masking.

Hamilton[10] by use of the tachistoscope exposed a line of print at a speed allowing a single fixation with instructions for the observer to read from the left as far as possible. Typically, the observer read the first word or two correctly and beyond that made a guess which had some resemblance to the next word. The observer using such cues as general word shape, context and easily recognized prefixes and suffixes was able to supply an additional word. However, since the first word of the line was fixated, only half of the peripheral retina was utilized.

By extensive use of the tachistoscope in visual and reading improvement programs and by teaching students to fixate so as to take full advantage of the retinal cone mosaic nasally and temporally, Walton[11]

has found that with a 1/100 of a second exposure, approximately 29 letter spaces or 5 words of 5 letters each may be read. About 17 letter spaces or 3 words of five letters are seen relatively clearly and by utilizing general word shape, context and familiar letter groups a word at either end of the central fixation point may be deduced. These observable results correspond closely to those that may be calculated on the basis of peripheral visual acuity, evaluating the vertical and horizontal components of the letters and the effects produced by masking of the letters in indirect vision.

SACCADIC EYE MOVEMENTS AND REACTION TIME

The function of the saccadic eye movement in a reading situation is to carry the eyes from fixation to fixation with the extent of the movement being determined by the number of words perceived at each fixation. A movement over a space of five letters of ordinary print, at a reading distance of a foot, takes 15 to 20 ms., or about 1/60 of a second. Table II from Dodge & Cline[12] gives the duration of longer movements, their extent being measured by the angle through which the eye swings. The table gives the averages derived from 3 subjects.

TABLE II

DURATION OF SACCADIC EYE MOVEMENT

Extent of Movement	Duration of Movement
5°	29 ms.
10°	39 ms.
15°	48 ms.
20°	55 ms.
30°	80 ms.
40°	100 ms.

For movements of twenty degrees or less, along a page held a foot from the eyes, each degree means approximately 1/5 of an inch, so that 5° = 1 inch, 10° = 2 inches, 15° = 3 inches, and 20° = 4 inches (more precisely, 4.23 inches.)

Although it might be assumed that the reaction time of the saccadic movement is very short, it is actually about the same as that of a hand response to a visual stimulus. The saccadic response to a stimulus appearing in indirect vision was found to be on the average 195 ms. with a range of individual averages from 125 to 235 milliseconds.[13] More recently Westheimer,[14] by use of two neon bulbs which could be moved to any position on a horizontal arc of 150 cm. radius, determined a reaction time which varied between 120 and 180 ms.

In a reading situation, at each fixation a period of time, the reaction time, elaspes before the next saccadic movement is initiated. Obviously, the duration of the saccadic movements and the reaction time are limiting factors that must be considered in determining the ultimate speed that may be achieved in reading.

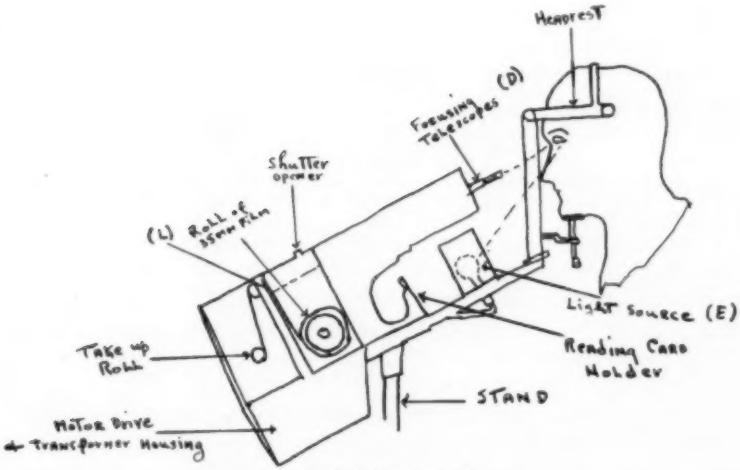


Fig. 1. Ophthalmograph.

APPARATUS

The apparatus, Figure 1, the ophthalmograph produced by the American Optical Company[15] consists of three main parts, the stand, headrest and camera.

The headrest provides sufficient pressure to help the subject hold his head steady.

Light from a direct source (E) is reflected from the two corneas and focused on the film (L) by means of lenses mounted in telescoping tubes (D). These tubes may be moved in any direction to locate the beams of light from the corneas and thus make allowance for different pupillary distances.

The film in the camera is traveling upward at a constant speed of ½ in. per second with the emulsion side toward the subject.

SUBJECTS

Ten subjects were used in conducting this investigation. Of this number, one was an assistant professor at the Los Angeles College of Optometry and the remainder students of the senior class. Thus the participants were trained observers. All subjects were males ranging in age from 24 to 35 years.

PROCEDURE

The procedure was designed to duplicate eye movements and fixations as utilized in a reading task while eliminating the factor of comprehension, thus providing a means of determining the reaction time per

fixation. To gain this information the following card (Figure 2) was designed for use in the reading card holder of the ophthalmograph.

hat	map	may	key	mac
mad	hat	sad	sat	let
mal	tee	man	tan	fee
can	top	lap	cop	set
rot	tik	see	mop	hot

Fig. 2. Arrangement of card used in determining reaction time.

Prior to being tested, each subject was thoroughly familiarized with the methodology, being given a duplicate of the card used in the experimental procedure. Five minutes of practice in quickly fixating each word was required, with instructions that during the test, maximum effort should be utilized so as to achieve the greatest speed in performance.

RESULTS

The reaction time was determined by projecting the ophthalmographic film strip upon a screen and measuring the length of each fixation. These calculations were converted to a time factor (milliseconds) based upon the fact that the film strip moves through the ophthalmograph at a speed of 0.5 inch per second.

The results are tabulated in Tables III and IV.

Buswell[16] has found that the average duration per fixation in silent reading for college students is 252 ms. which is only 33 ms. longer than determined in this study where comprehension was not a factor.

In 70% of the cases regressions occurred at the beginning of four of the five lines. While the longest reaction time was determined on the basis of a single fixation, the time required to consummate fixation of the first word would also include the duration of the regression. The greatest lapse of time in 80% of the cases occurred at the beginning of the line due to the appearance of the longest fixation or the combination of the first fixation and regression.

Woodworth[17] reports that the greatest amount of time is spent fixating the first quarter of a line of print, explaining that what lies further to the right is receiving some preliminary examination during this period of time. In view of peripheral visual acuity and masking, this explanation seems unlikely. However, the present investigation clearly indicates that the greater amount of time required at the beginning of a line is due to visual factors.

It is interesting to note the rather large range existing between the shortest and longest reaction time indicating that factors other than comprehension enter into the determination of the duration of fixation.

TABLE III

REACTION TIME
(Milliseconds)

Identification	Mean Reaction Time	Shortest Reaction Time	Longest Reaction Time	Difference Longest—Shortest Reaction Time
S.S.	292	170	450	280
R.M.	183	120	300	180
T.B.	172	125	260	135
E.H.	248	165	400	235
J.H.	170	115	275	160
O.K.	169	125	300	175
R.V.	194	120	350	230
C.S.	309	200	400	200
J.S.	254	150	315	165
B.L.	200	115	250	135

TABLE IV

ANALYSIS OF REACTION TIME
(Milliseconds)

Number of Subjects	Mean Reaction Time	S.D.	SE Mean
10	219	49.8	15.7

DISCUSSION

Ophthalmographic studies of adults who have not had the advantage of reading training indicate that they generally read by fixating each word. Buswell[18] has reported approximately ¼ sec. as the average duration of fixation. Considering the time intervals for interfixations as shown in Table II, average reading rates may be calculated. This is shown diagramatically in Figure 3.

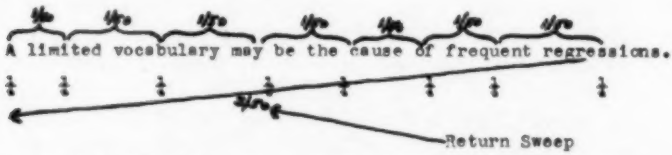


Fig. 3. Typical adult reading pattern. Reading rate of 220 words per minute. 1/50 and 3/50 second, saccadic movements. 1/4 second being the duration of fixation.

The above reading speed falls within the range given by Harris[19] of rates for various college and educated adult groups, the variation being from 207 to 290 words per minute. Harris says that 250 W.P.M. may be taken as a rough estimate of the normal reading rate for high school and college students, and adults.

Ophthalmographic investigations of college students reading non-technical material shows that the average span of recognition is 1.25 words per fixation.[20] Using the same values as in the previous example

with the exception of 8 fixations per line, the reading rate is 272 W.P.M. as shown in Figure 4. Again this is within the range as shown above.

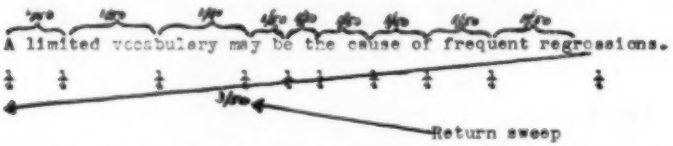


Fig. 4. Typical college student reading pattern. Reading rate of 272 words per minute. 1/50 and 3/50 second, saccadic movements. 1/4 second being the duration of fixation.

It is important to know the potential reading speeds that may be achieved when completely reading the printed page. Considering the anatomical and physiological limiting factors of peripheral visual acuity, masking, saccadic eye movements and reaction time, calculations may be made that will approximate this potential. Various relationships among these factors are shown in Table V.

TABLE V

READING RATES

(Calculated on basis of 10 word line)

Reaction Time	Number of Fixations	Interfixations		Return Sweep		Reading Rate W.P.M.
		No.	Time (Sec.)	No.	Time (Sec.)	
1/5	3	2	1/33	1	1/20	853
1/5	2	1	1/25	1	1/25	1250
1/6	3	2	1/33	1	1/20	982
1/6	2	1	1/25	1	1/25	1451

The average reaction time as determined by this study was 219 ms., slightly slower than 1/5 sec. Deducting one standard deviation (49.8 ms.) thereby including approximately 80% of the population, gives a reaction time of 169.2 ms., which is about 1/6 sec. Therefore the calculations in Table V were made on the basis of 1/5 and 1/6 of a second.

In view of the peripheral visual acuity curve and the effects of masking in indirect vision, three words may be seen relatively clearly, and by utilizing general word shape, context and familiar letter groups, a word at either end of the central fixation point may be deduced. Thus calculations were made on the basis of 3 and 2 fixations per line.

How close an individual may come to reaching the limiting anatomical and physiological factors will depend upon such other considerations as educational background, experience, I.Q. and vocabulary.

The data indicate that if an individual is reading faster than 1,451 W.P.M., he is skimming: this reading skill is primarily concerned with

locating and grasping main ideas. The data further indicate that it is not possible to grasp a page or a paragraph with a single fixation.

SUMMARY AND CONCLUSIONS

Within the past few years numerous reports have appeared in various periodicals describing phenomenally high speeds achieved by students of rapid reading training programs.

These reports must be considered in relation to present knowledge regarding vision and evaluated in view of Javal's significant discovery that the eyes move along a line of print by saccadic movements with intervening fixation pauses.

On the basis of peripheral visual acuity and masking, three words of 5 letters each may be seen relatively clearly, and by utilizing general word shape, context and familiar letter groups, a word at either end of the central fixation point may be deduced.

The ophthalmograph was used to determine the reaction time of ten subjects in a reading situation in which comprehension was completely ignored.

The results showed the following:

1. The mean reaction time was 219 ms., which is only 33 ms. shorter than the average duration per fixation for college students in silent reading.
2. The greatest lapse of time occurred at the beginning of the line due to the appearance of the longest fixation or the combination of the first fixation and a regression.
3. The investigation indicates that the greater amount of time required at the beginning of a line is due to visual factors.
4. The large range existing between the shortest and longest reaction time indicates that factors other than comprehension enter into the determination of the duration of fixation.

Considering the limiting anatomical and physiological factors of peripheral visual acuity, masking, saccadic eye movements and reaction time, potential reading speeds may be calculated.

Reading rates of over 1,451 W.P.M. indicate that the individual is skimming.

The data indicate that it is not possible to grasp a page or paragraph with a single fixation.

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ANNOUNCEMENT

THE OPTICAL FAIR — CHICAGO IN JUNE

Those optometrists who attended the 1954 Optical Fair in Chicago will remember it (1) for the wealth of materials and equipment on display and (2) for the crowds that made this the most jam-packed optical event on record. By far the largest group in attendance were optometrists. It was estimated that there were more than 3,000 optometrists registered.

This year, again at the Palmer House, Chicago, June 7-10, the Optical Manufacturers Association is repeating the Optical Fair with all the old features and some new ones, i.e., better entertainment, lectures and live style shows.

Optometrists are now urged to plan their June vacations to include at least a day or so at the Optical Fair in Chicago. The displays will be the largest in history and the entire event is geared to record breaking proportions. The dates are June 7-10, 1957. The place, the Palmer House, Chicago. Your host, The Optical Manufacturers Association, who will welcome you royally.

VISUAL PROBLEMS IN INDUSTRY—PART II*

(F) THE EFFECT OF THE SURROUND UPON THE PERFORMANCE OF A TASK REQUIRING CENTRAL VISION.*

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(1) THE NATURE OF THE PROBLEM.

The nature of this problem is illustrated in Figure 6. This figure represents the field of view of a lathe operator attempting to read a micrometer. The circle which has been added to the picture represents the boundary at the central 5 degree portion of the field of view. The peripheral part of the field (outside the circle) is commonly called the surround. According to current concepts, maximum performance can

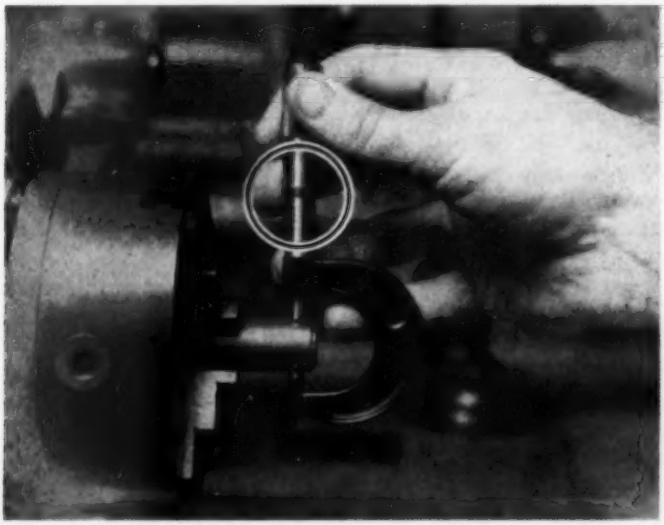

Fig. 6. Division of the field of view into a periphery or surround and a 5-deg. central portion.

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Part I of this report appeared in the January, 1957, issue. Part III will appear in the March issue.
*The material in this section is based on an article by the author which has been published in the Eng. Experiment Station News.[10]
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be achieved when the surround is uniformly bright and has the same value as the average brightness in the central portion.

It is our purpose to specify what deleterious effects on visual performance accrue from raising or lowering the surround brightness or from introducing non-uniformities into the surround.

A warning should be introduced at this point to prevent confusing this problem with the effect of the distribution of lines, points and contrast borders and gradients in the immediate vicinity of the critical detail which has to be seen.

To illustrate the danger Figure 7 is presented. The visual task is

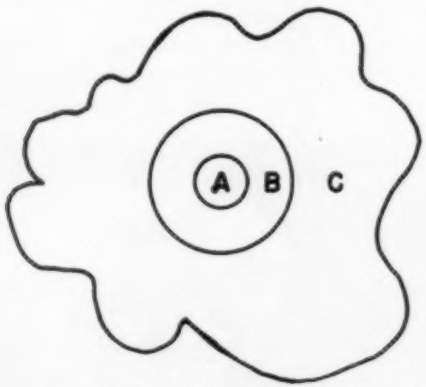

Fig. 7. Pattern for testing effect of brightness of surround upon visibility of an object in the central portion of the field of view; diameter of boundary between *B* and *C* should subtend at least 5 deg. at the eye in order to avoid the effect of contrast between *C* and *B* upon the visibility of *A*.

to detect the brightness difference between A and B, and this is found to be affected by changing the brightness of the surround C if the width of zone B is less than one degree of visual angle. However, it is not the change in brightness of the surround per se which produces the effect but the change in contrast at the border between B and C.[11, 12, 13, 14]

When the boundary between B and C is 5 deg. or more in diameter the change in contrast at this border does not affect the visibility of A, and since this factor is eliminated under these conditions one can proceed to investigate the effect of brightness of surrounds per se.

The problem can best be approached by considering separately the several means by which brightness and chromaticity in the periphery of the field of view can affect foveal vision. To keep this discussion strung out in a step by step sequence, it will be limited at the outset to those

factors which apply to the case of an immobile eye in a fixed environment. After these facts are weighed, the effect of eye movements and changes in the visual environment will be considered.

(2) IMMOBILE EYES IN A FIXED ENVIRONMENT.

There are jobs which require the observer to keep his eyes converged at a given point over a considerable period of time. During this time the eyes may make momentary short excursions away from and back to this point, but essentially we can treat such a job as one which gives us immobile eyes in a fixed environment. Also, in a task like reading, the eyes jump from point to point along the lines of print, but at each stop the distribution of brightness and chromaticity in the visual field is essentially the same as in the preceding stop, and we can assume that this task is equivalent to one in which the environment is fixed and the eyes are immobile.

(a) Stray light. One of the known ways in which brightness in one part of the field of view can effect the visibility of objects in another part of the field of view is through the medium of stray light in the eye. The stray light in an eye is superimposed upon the retinal image of the object or objects which the observer is trying to see and except in rare instances interferes with the visibility of these objects.

At present, one cannot determine the total amount of stray light by evaluating individually the separate factors that contribute to it, such as flare, halation, scattering by the media, reflection from the coats of the eye, transmission through the sclera, etc. One can, however, measure the effect of a glare source in the periphery of the field of view upon the visibility or apparent brightness of an object at the center of the field and compare it with the effect produced by a patch of veiling brightness superimposed upon the object.

Holladay[15] and Stiles[16] have shown that a point source at an angular distance Θ (degrees) from the point of fixation produces an effect at the fovea which is equivalent to a veiling brightness having a brightness Bv (candles per square foot) given by the following formula:

$$Bv = kE\ \Theta^{-n} \qquad (1A)$$

In this equation k and n are constants, and E (footcandles) represents the illumination in a plane through the center of the entrance pupil normal to the line of sight. Stiles investigated this effect for values of Θ between one and ten degrees and found values of 4.16 and 1.5 for k and n. Holladay investigated the effect for values of Θ between 2.5° and 25° and found values of 9.2 and 2 for k and n.

Equation (1A) was found to hold for glare sources in any meridian in the field of view. A slightly higher value of Bv is found

when the glare source falls on the blind spot.

Stiles[17] in attempting to determine whether these effects might be due to stray light concluded that flare and scattering by the media cannot account for the whole effect. However, the writer[18] has shown in a re-evaluation of the effect of scatter by the media that the effect can be attributed to stray light. Moon and Spencer[19, 20] have also arrived at the same tentative conclusion. The fact that the equivalent veiling brightness is directly proportional to the intensity of the glare source, and the fact that the effects of two or more glare sources are strictly additive, both conform to the stray light hypothesis.

Data of this type described above have been acquired without controlling the size of the pupil and consequently, when an equation like 1A is used for computing the combined effects of a number of glare sources, allowance ought to be made for variations in pupil size. It may be tentatively assumed, however, that no allowance needs to be made, Stiles having shown, in fact, that the error is small.

A more serious problem is that equation 1A cannot be applied to small values of θ. It leads to an absurdity when one attempts to integrate effects for different parts of the field.

As shown in Figure 6, the following equation conforms reasonably well to the data of both Stiles and Holladay and for small angles is consistent with the theory of scatter by the media.

$$Bv = \frac{9.2E}{\theta\ (1.5 + \theta)}. \qquad (2)$$

It is proposed that this equation be used in computing the stray light at the fovea. In the case of a multiple number of sources,

$$Bv = 9.2\left(\frac{E_1}{\theta_1\ (1.5 + \theta_1)} + \frac{E_2}{\theta_2\ (1.5 + \theta_2)} + \ldots + \frac{E_n}{\theta_n\ (1.5 + \theta_n)}\right). \qquad (3)$$

In the case of non-uniform distribution of brightness in the field of view an equation for Bv may be derived as follows:

If we define direction in the field of view in terms of the half-meridian ϕ and the angle of eccentricity θ, the illuminance dE in the plane through the center of the entrance pupil normal to the line of sight produced by the brightness B, in a given direction is given by the following equation:

$$dE = B \cos\theta \sin\theta\ d\theta\ d\phi \qquad (4)$$

where θ and ϕ are expressed in radians, and where $\cos\theta$ = cosine of

the angle of incidence, and sin θ dθ dϕ = an element of solid angle. Substituting this into Equation 2, expressing θ in radians instead of degrees, and integrating for values of θ from zero to $\pi/2$, we obtain:

$$Bv = 9.2 \int_0^{2\pi} \int_0^{\pi/2} \frac{B \cos \theta \sin \theta \, d\theta \, d\phi}{57.3\,\theta\,(1.5 + 57.3\,\theta)} . \qquad (5)$$

For the special case of a uniform circular patch of luminance concentric with the line of sight, and having a radius equal to $\bar{\theta}$, Equation 5 reduces to

$$Bv = 18.4\ \pi\ B \int_0^{\bar{\theta}} \frac{\cos \theta \sin \theta \, d\theta}{57.3\,\theta\,(1.5 + 57.3\,\theta)} \qquad (6)$$

and if one substitutes sin θ for θ, which holds for small values of θ, Equation 6 reduces further to

$$Bv = \frac{18.4\ \pi B}{(57.3)^2} \log_e\ (1 + 38.2 \sin \bar{\theta}) . \qquad (7)$$

In the case of a uniform field of brightness B extending from $\theta = 0°$ to $\theta = 90°$, the portion of the field outside the 5° central region produces at the fovea a value of Bv which is only 4.73 per cent as great as B.

Consequently, a uniform surround equal to the brightness of the immediate background of the test object cannot be objected to on the ground that it produces harmful stray light. The advantages far outweigh the very small loss in contrast resulting from the veiling brightness produced by the stray light.

Stray light can also be ignored when the surround is non-uniform, provided the field of view is free from objects which are a great deal brighter than the immediate background of the test object. However, in the case of street lighting, automotive headlights, and many types of industrial lighting the effects of stray light have to be taken into consideration.

When a uniform patch of veiling brightness such as produced by stray light in the eye is superimposed on a brightness contrast border, the resulting apparent contrast (C′) is given by Equation 8 where Bv is veiling brightness and B_1 and B_2 are the brightness of the two contrasting areas which constitute object (2) and background (1). The apparent brightnesses (B'_1 and B'_2) of the contrasting areas are given by Eqs. 9 and 10.

$$C' = \frac{B_1 - B_2}{B_1 + Bv} \qquad (8)$$

$$B'_1 = B_1 + Bv . \qquad (9)$$

$$B'_2 = B_2 + Bv \ . \qquad (10)$$

(b) Pupil size. Another known way in which the visibility of an object in one part of the field is affected by the brightness in another part of the field is through the effect on pupil size. This effect is particularly important in situations where sharpness of the retinal image is important.

Reeves[21] data (for six subjects for the effect of variations in brightness of a large uniform field) and data by Luckiesh and Moss[22] for the brightness of centrally fixated disks of different sizes, required to maintain the pupil at constant size indicate a relation between pupil size and brightness distribution.

Although a great deal of data are available relative to effects of concentrated sources at various angles from the line of sight and various types of non-uniform distributions,[15, 17, 23, 24] it is not possible yet to predict the size of the pupil for various types of non-uniform distributions of brightness in the visual field.

Having shown that manipulating the brightness distribution in the field of view will affect the size of the pupil, one must next consider the advantages of making the pupil larger or smaller. First of all, enlarging of the pupil permits more light to enter and in general increases the visibility of an object. When, however, the eye is subject to extreme aberration or is out of focus by reason of refractive error uncompensated by the accommodation of the lens, or by inability to focus properly for near objects, visibility can be improved by constricting the pupil. Theoretically, constricting the pupil would ultimately lead to blurring from diffraction, but it is not possible to constrict the normal pupil to the point that diffraction becomes an important factor.

(c) Peripheral Sources of Annoyance, Discomfort and Distraction. A given distribution of brightness in the periphery of the field of view may be uncomfortable, annoying or distracting and indirectly affect the performance of a task which depends upon foveal vision. This factor appears to be important in the experiment conducted by Luckiesh and Moss.[25, 14] They studied the effect of the angular size of a bright background upon the ability of an observer to keep the lower of two black objects vertically aligned with the upper which moved back and forth laterally in an unpredictable fashion. The precision of this operation improves as the size of the background increases up to the point that its diameter subtends 30 deg. of visual angle.

(d) Framework for Orientation in Space. There must be enough articulation of the periphery of the field of view to provide the necessary framework to keep the worker properly oriented in space.

(e) Control of Accommodation. As McFadden's experiment[26, 14] shows, an articulated background is also useful in controlling accommodation of the eyes.

(3) MOBILE EYES AND CHANGING ENVIRONMENTS.

In considering head and eye movements we have to deal with the distribution of brightness and chromaticity surrounding the worker with reference to his several directions of regard and the effect of what he sees at one moment upon what he sees at the next. In many jobs, the objects which have to be seen are confined to a small space, and theoretically, it would never be necessary for a person to move his head or eyes. Even at such a job a person will move his eyes periodically to other parts of his environment. In other types of jobs it may be necessary to look first in one direction and then in quite a different direction, or to move the whole body from one point to another.

There are also jobs in which the distribution of brightness and chromaticity in the field of view undergoes continuous change, and in order to evaluate the capacity of the eye to perform at a given moment it is necessary to keep track of what was happening in the field of view during the period just preceding.

The principal effects to be considered are the changes in adaptation and fluctuations in pupil size.

(a) Changes in Adaptation. Changes in adaptation occur whenever there is an increase or decrease in brightness in the observer's field of view or whenever the eyes switch from one fixation point to another. It may involve simply a change in direction of fixation but it may involve a movement of the head or body or a change in the position of the observer as he moves from one part of the room to another or from one room to another.

The harmful effect of changes in adaptation occurs in going from a high level to a low level. If, for example, the eyes turn from a given task and gaze at an area of high brightness, performance is temporarily impaired when the eyes turn back to the original task.

For this reason the illuminating engineer must avoid patches of brightness in the observer's field of view which are much in excess of the brightness of that part of the field which contains the task.

Another aspect of the problem is illustrated by having the eye look at a confusion pattern such as that shown in Figure 8A and then at a small disk Figure 8B which is differentiated from its background by a small difference in brightness.[27] The visibility of the disk is impaired by the observer having looked at the confusion pattern previously. This can be avoided to a large extent by creating an environment which is

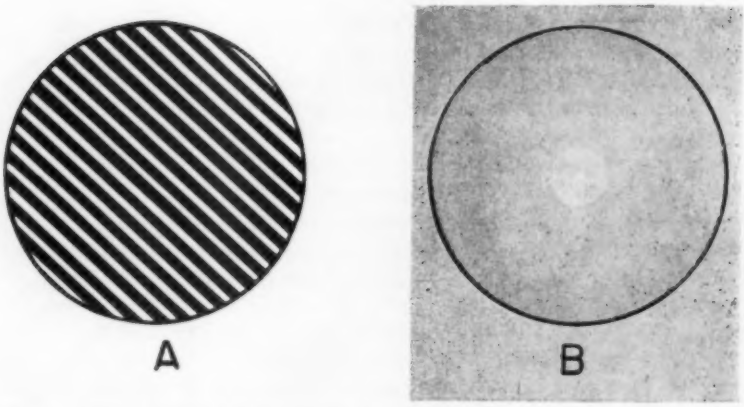

Fig. 8. Stimulus pattern for demonstrating the effect of an after-image of a confusion pattern upon the visibility of a low-contrast object.

free from shadows and from complicated high contrast patterns.

(b) Chromatic Adaptation. As already indicated above, the chromatic adaptation is affected by the distribution of brightness and chromaticity in the field surrounding the worker. Stray light and movements of the head and eyes make it possible for each part of the field to affect the chromatic adaptation at each part of the retina.

(c) Changes in Pupil Size. A change in the size of the pupil accompanies each change in the distribution of brightness in the visual field. There are not enough data available at present nor is enough known about the neuromuscular mechanism to predict the size of these fluctuations.[28]

(4) MANIPULATION OF THE SURROUND. If we find a bad distribution of brightness in the field of view of a given worker, it is natural to ask what can be done about it. This will depend on the particular situation but there are two general principles which must be kept in mind.

On the one hand if the distribution of brightness which surrounds the object is good, and the distribution of brightness in the field surrounding the entrance pupil of the eye is bad, then one should aim at modifying the latter without changing the former any more than necessary. The use of light shields which hide the light source from the eye but keep it exposed to the object illustrates the general principle.

In most industries, we find a number of workers in the same environment and a light source which is used to illuminate the work of

one worker may constitute a glare source for another worker. This problem is so critical in some industries that the workers are kept in separate booths with separate systems of illumination provided for each worker.

A careful design and arrangement of machines and light sources and light controls can provide a partial solution to this problem.

(IV) PROVIDING LIGHT FOR JOBS THAT REQUIRE PERIPHERAL AS WELL AS CENTRAL VISION.

Many jobs require the worker to see simultaneously, objects in different parts of his field of view. This job will have to be analyzed by determining characteristic positions of the head and eyes while performing the work, to determine which objects are seen with foveal vision and which objects are seen with peripheral vision. Lighting for peripheral vision differs somewhat from that for central vision in that in peripheral vision detail cannot be appreciated and lighting to bring out detail is not essential. Large areas with high contrast are the easiest to see.

Peripheral vision usually has to be emphasized where safety from moving objects and parts are involved, or where the worker himself is moving around.

(V) JOBS PERFORMED AT LOW LEVELS OF ILLUMINATION.

At extremely low levels of illumination, the primary aim is to preserve a state of dark adaptation by removing all bright objects and bright flashes from the field of view. At extremely low levels nothing can be seen with the fovea and the observer has to be taught how to scan the field with his eyes to get the best results on how to look at things out of the corner of his eye.

(VI) ATMOSPHERIC ABSORPTION AND SCATTERING.

In most industries the worker and his task are included in a small environment so that the effect of atmospheric absorption and scattering can be completely ignored. However, industries which make use of headlights, signals and searchlights are much concerned with atmospheric scattering and absorption. This involves both the illumination of the object which needs to be seen and the viewing of the object by the observer. Most of us have had the opportunity of encountering these problems first hand by attempting to drive automobiles through fog. Time does not permit us to discuss the many technical phases of this problem. These various phases of the problem are discussed in the IES Lighting Handbook[4] and in Middleton's book, "Visibility in Meteorology."[29]*

*Part III of this report will appear in the March issue.

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The Publishers Authorized Bindery Service have advised us that because of increased costs they are making a slight change in their charges for binding 12 issues (one volume) of this publication.

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PRESENTATION OF PAPERS AT ANNUAL ACADEMY MEETING

The annual convention of the American Academy of Optometry in December of each year is without question the outstanding annual educational optometric event in the United States and Canada. There are many factors which make this so. The individual discussions one has with leading practitioners and educators from all parts of the continent becomes more valuable to all who participate as the years go by. The excellence of the Academy post-graduate courses alone makes the trip worthwhile. The fact that the business sessions are held to a minimum provides nearly a full week for educational activities. The never to be forgotten experience of taking part in a day-to-day program devoted to significant original papers brings many to the convention year after year, and of course, this presentation of papers is the main reason for holding this annual meeting. It is the purpose of this report to invite papers for the next December meeting and to suggest that the

planning for these be started now. In addition, the writer will include a few suggestions concerning the presentation of papers at these meetings.

By tradition, the papers presented before the Academy have always been read. This is customary in all scientific organizations. In some instances, if time permits, the author explains certain points in an informal manner which may add to the interest with which the paper is received. In general, it is wise to adhere quite closely to the script to avoid rambling and the possibility of being misquoted.

Those not accustomed to giving papers would do well to read their papers aloud at least once or twice before presenting them. Occasionally, one writes a word which sounds quite unusual when spoken aloud. Pronunciation of unusual words in all cases should be checked. It is also possible with a little practice to put more expression into one's reading which helps listeners to understand the meaning more clearly. This also enables one to accurately time the presentation.

A more complete delivery can frequently be made by the preparation of simplified charts and abbreviated tables for viewing, during the oral dissertation. The curves and captions of each chart should tell their story at a glance. Slides should contain only the essential data necessary to make a desired point. Material on slides should not be crowded.

In a program as full as that of the annual meeting of the Academy, timing is of the essence. In fairness to all of the members presenting papers, it is necessary that every speaker adhere to the time allotted him on the program. Once a program falls behind time, it is extremely difficult to get back on schedule as the program progresses. It is therefore essential for the program chairman to make all speakers adhere closely to their schedules. It is also suggested that the maximum available time be left for a discussion period, as is always outlined in the official program. The comments and questions raised in the discussion period many times prove of value not only to the audience but to the speaker as well. It is quite difficult to guess the length of time it takes for a presentation of a paper. Before requesting a specific amount of time (usually 30 minutes) it is advisable to actually time the presentation of your paper. In general, papers require 1½ minutes of reading time for each page of double spaced typewritten material on 8½"x11" paper.

To insure proper discussion it is suggested that copies of the paper be sent to other members known to be interested in the subject. If this is done well in advance of the annual meeting, it gives these members an opportunity to study the pertinent points of the paper, and bring out essential comments and questions. Most members of the Academy will be pleased to cooperate with the speaker in this regard. The program

chairman will make arrangements for a discussion leader if desired.

The Academy must present a well balanced program from the standpoint of subject-matter, length of papers, and general interest in the material which will be presented. Titles, for example, can at times be misleading. In all instances titles of papers should be carefully chosen and even a short explanatory sub-title may be necessary to properly catalog the material. The necessity of submitting a copy of your paper to the chairman of the committee cannot be over-emphasized as all papers are screened before being assigned a place on the program.

The presentation of original papers at the Academy meeting is one of the annual educational highlights of our profession. It is recognized that the reason for the presentation of papers is to advance the art and science of optometry and to enrich the literature. Members in attendance expect and have always received interesting presentations. The practice of reading the paper aloud in advance of the meeting: the selection of proper slides for projection purposes: the close adherance to the allotted time scheduled: the use of a discussion leader: the proper summary of detailed material and involved charts are part of the techniques that make the program successful. The submission of your paper to the committee preferably on or before September 1, 1957, will help make a more enjoyable program at the annual meeting in December. Academy members everywhere should now start outlining and reviewing the material they plan to present at the coming Academy meeting in Chicago.

RALPH E. WICK.

SPECIAL REPORT

WHITE SULPHUR SPRINGS CONFERENCE ON A.O.A. LONG RANGE PLANNING*

More than a dozen subjects of major importance to the future of optometry and the vision welfare of the American people were discussed in an exploratory conference on long-term planning at the Greenbrier Hotel, White Sulphur Springs, West Virginia, January 20-22, 1957.

Twenty-one A.O.A members, appointed by Dr. Rupert E. Flower, Visalia, California, president, A.O.A., participated in the conference. Dr. Flower presided at the day and night sessions during the three days. Participants were selected for their knowledge of and familiarity with the subjects discussed, and not as spokesmen for any organizations or institutions.

The exploratory aspect of the conference was emphasized by Dr. Flower who pointed out that the group was not empowered to form policy. A Long-Term Planning Committee is to be appointed to carry out a resolution passed at the A.O.A. Congress in Miami Beach, Florida, in June, 1956. That Committee, which will report to the House of Delegates at the Los Angeles Congress in June, 1957, will be selected from those who heard and participated in the 30 hours of discussion at the Greenbrier. To encourage free discussion, no stenographic record was made and no resolutions were passed or other formal action taken.

It was the consensus of the group that the key to the future of the profession is a specialized optometric service to the the public. This keynote was struck within a few minutes after the conference opened, and other topics, such as education, interprofessional relations and economics, were discussed as related parts of that theme.

It was recognized that a growing problem for many professions will be "overlapping fields," and the consensus was that such a problem is best met by cooperation. Optometry, medicine, education and psychology are among the major groups with overlapping functions related to vision. Closer co-ordination of efforts among all optometrists and optometric organizations was urged as an aid to interprofessional relations.

It was recommended that even more emphasis should be placed on the fact that A.O.A. does not favor the extension of optometry into

*From an American Optometric Association report prepared by John C. Patterson and J. Harold Bailey of February 6, 1957.

medicine, such as the use of drugs, and that it does not desire to restrict ophthalmologists from refraction.

The O.D. degree was considered necessary to optometry, and plans should provide for the universal adoption and uniform use of it.

Both university and unaffiliated schools of optometry were considered essential for the best interests of the public and profession. Great stress was placed on the need for optometrists themselves to support the schools of optometry and encourage youth to select the profession as a vocation. It was pointed out that enrollment in optometry schools must be doubled to meet the attrition of the profession by death and retirements and provide for the growth in population.

In connection with the fear of "over-expansion," an informal survey among those at the conference showed that many of the most financially successful optometrists are in communities where the ratio of population to vision-care practitioner is less than 3,000 to 1, compared to the national average of about 8,000 to 1. The inference was that where optometrists provide a specialized, complete, and satisfactory optometric service the public knows it, appreciates it and willingly pays for it. It was recommended that an attempt should be made to compile a reliable figure on the number of optometrists actually in practice.

The mood of the conference was strongly optimistic; the group urged growth and expansion. The feeling was that more optometrists providing more optometric service beyond refraction and dispensing, such as vision training, fitting of contact lenses, subnormal vision aids and correction of aniseikonia, will be beneficial to the public and the profession itself.

Many at the conference contended that most of the economic distress in optometry not traceable to incomplete optometric service is among young practitioners who have been out of school less than five years, and this should be considered as a major problem for which a solution must be sought. Statistics were also cited which indicated that in many states a higher percentage of optometrists than members of any other profession fail state board examinations, and it was felt that this probably discourages young graduates and also prospective students.

Expansion of post-graduate education and research was considered essential to further the practice of a specialized vision-care service.

Greater uniformity in pre-optometry requirements for entrance to optometry schools should be, and probably can be, achieved, and it was felt that this will encourage more general arts and science colleges to offer pre-optometry curricula.

Because time was too short even in a three-day conference, the dis-

cussion was confined in so far as possible to goals rather than means of achieving them, and the "pros" and "cons" of most of the basic questions affecting the future of the profession were thoroughly aired.

"A major revelation of the long-term planning conference," said Dr. Flower, "is the near unanimity of views of the optometrists who are often believed to differ widely on the basic subjects under discussion. After this exploratory conference I have unbounded confidence in the future of optometry and the unification of our profession on goals and methods of reaching them."

Members participating in the conference were: E. B. Alexander, O.D., Duncan, Oklahoma; Harry G. Beiling, O.D., Louisville; Lois B. Bing, O.D., Shaker Heights, Ohio; Harold L. Carlson, O.D., Mankato, Minnesota; John D. Costabile, O.D., Wilson, North Carolina; William C. Ezell, O.D., Spartansburg, South Carolina; Rupert E. Flower, O.D., Visalia, California; Don A. Frantz, O.D., DeKalb, Illinois; Glenn A. Fry, O.D., Columbus; William Greenspon, O.D., Bluefield, West Virginia; Henry W. Hofstetter, O.D., Bloomington, Indiana; Bruce D. Jaques, O.D., Los Angeles; Mervyn H. Kauhl, O.D., Cleveland; Carel C. Koch, O.D., Minneapolis; Felix A. Koetting, O.D., St. Louis; Roger O. Lindquist, O.D., Minneapolis; Capt. David S. Naylor, U.S.A.F.; John D. Perry, O.D., Winston-Salem, North Carolina; Hoyt S. Purvis, O.D., Jonesboro, Arkansas; Richard C. Schiller, O.D., Marshalltown, Iowa; Lester H. Sugarman, O.D., Meriden, Connecticut. Also present were J. Harold Bailey, A.O.A. administrative director, Harold Kohn, Esq., legal counsel, and John C. Patterson, public relations counsel.

CURRENT COMMENTS

Terry Judith Parkins
Editorial Assistant

Optometrists will confer a favor by sending news items of general interest for this department; such as relate to new instruments, clinical techniques, education, visual health and optometric legislation and organization.

CLEVELAND CONFERENCE ON VISUAL PROBLEMS IN SCHOOLS

The 10th Annual Forum of Visual Problems in Schools and the 10th Annual Reading Conference will be held in Cleveland, March 1-3, 1957, at the Statler Hotel. The program is arranged for optometrists and elementary school teachers. The registration fee for the three-day program will be $18 which includes a banquet ticket. A number of technical papers will be presented. These are:

"Teaching Implications for the Brain-Damaged Child," Dr. W. M. Cruickshank, Syracuse University, Syracuse, New York.

"Visual Behavior of the Brain-Damaged Child," Dr. N. C. Kephart, Purdue University, Lafayette, Indiana.

"Optometric Vision Care of the Brain-Damaged Child," Dr. Max Denman, Stuttgart, Arkansas.

"Optometric Vision Care of the Partially-Seeing Child," Dr. Daniel Woolf, New York City.

"Demonstration of Visual Aids for the Partially-Seeing Child," Dr. William Policoff, Wilkes-Barre, Pennsylvania.

"Making Reading Fun Through a Knowledge of Reading Skills," Dr. Emmett E. Betts, Betts Reading Clinic, Haverford, Pennsylvania.

"Keeping Reading Fun Through an Understanding of Child Development, Vision and Reading," Dr. Frances Ilg, Gesell Institute of Child Development, New Haven, Connecticut.

"What Research Has to Say About Vision and Reading," Dr. Charles Huelsman, Miami University, Oxford, Ohio.

"Making Reading Fun Through and Appreciation of Literature," Marguerite Henry, Rand McNally Company, Chicago.

"Visual Training," Dr. Marguerite and Anita Eberl, Milwaukee.

Dr. Lois B. Bing, Shaker Heights, Ohio, is in charge of the meeting, which is jointly sponsored by the Northeastern Ohio Chapter, American Academy of Optometry; the American Optometric Association and the Ohio Council of the International Reading Association. At a special optometric meeting to be held during the conference optometrists will hear Dr. Rupert E. Flower, Visalia, California, president of the American Optometric Association; Dr. Lester H. Sugarman, Meriden, Connecticut, president-elect, A.O.A., and Dr. H. Ward Ewalt, Pittsburgh, treasurer, A.O.A.

NEWS BRIEFS

During 1956 national legislation setting up standards of optometric practice and placing qualified optometrists on an official register was secured in both Ireland and British Guiana. Similar actions are being considered in several other parts of the world. We wonder just what country will be next to report success in attaining optometric legislation and proper professional status during 1957. . . . The New England Council of Optometrists will hold its annual congress in Boston, March 10-13, at Hotel Statler. At the closing time for this department we did not have the official program, however, as usual, a large attendance is expected. Manufacturers will exhibit as in the past. . . . Dr. Darrell Carter, assistant professor of optometry, College of Optometry, University of Houston, and Dr. Foster Namias, associate professor of ophthalmic optics, Massachusetts College of Optometry, have been appointed to the National Board of Examiners in Optometry. Dr. Carter replaces Dr. Henry W. Hofstetter whose term on the board expired and Dr. Namias replaces Dr. Richard Feinberg who resigned. . . . In its 1957 institutional campaign, the Kahn Optical Company of Canada is now using 29 major newspapers to carry its eye conservation advertising. Both English and French papers are used and the campaign is designed to cover Canada from coast-to-coast. In addition to the newspaper ads stressing eye care, the company has arranged to have 192 Better Vision Institute, one-minute cartoon films shown on a Canadian TV network.

Dr. Alden N. Haffner was appointed on January 1, 1957, director of the Optometric Center of New York, 11 West 36th St., New York City. He succeeds Professor Isadore Finkelstein. Dr. Haffner is a resident of New York City. He received his A.B. degree from Brooklyn College in 1948. He received his O.D. degree from Pennsylvania State College of Optometry in 1952. He is a diplomate of the National Board of Examiners in Optometry and a Fellow of the American Academy of Optometry. Dr. Haffner is a reserve officer in the Medical Service Corps, U.S.A.R. On January 6 he was installed as international president of Omega Epsilon Phi optometric fraternity in Philadelphia. He is the grand chancellor emeritus of the Beta Delta Mu, National Service Fraternity. . . . Lt. Philip S. Robin, optometry officer, 2796th U.S.A.F. Hospital, Norton AFB, San Bernardino, California, has just completed a visual safety program for the military and civilian personnel on the base. . . . The Dvorine Pseudo-Isochromatic Plates have been accepted by the administrator for Civil Aeronautics Administration for use in testing color vision in certification of air pilots. The color plates were designed by Dr. Israel Dvorine of Baltimore. . . . The Therminon Lens Company, Des Moines, is now preparing a series of lawsuits against several optical laboratories who have been substituting other lenses in filling precriptions calling for the use of Therminon absorption ophthalmic glass.

Dr. Fred W. Hebbard joined the faculty of the School of Optometry, the Ohio State University, Columbus, January 1. He is a graduate of the School of Optometry, University of California. He is a member of the American Academy of Optometry, American Optometric Association, American Optometric Foundation, Phi Beta Kappa and Sigma Xi. His assignment at the Ohio State University will be in the field of clinical optometry. . . . At the quarterly meeting of the Better Vision Institute, M. J. Julian, president, reviewed some of the recent developments in their nation-wide program of public relations. The Institute has pioneered in the use of animated short films dealing with visual care; two reel color sound movies; Better Vision Institute spots on big-time live TV shows; five-minute films for TV use; a large number of radio platters dealing with eye care; news releases, feature stories and a fashion column stressing styles in eyewear; a new school vision chart; a driving safety manual; style brochures and consumer booklets all pounding home the need for periodic eye examinations. The meeting was held January 18 at the Park Lane Hotel, New York City. A large number of Institute directors were present and the 1957 plans were approved with enthusiasm. . . . The McLeod Optical Company, Provi-

dence, distributor organization for all I-Gard Products in the U.S.A., announce that 35 optical laboratories in various parts of the country now act as service distributors for these plastic lenses. . . . Dr. George N. Jessen, Chicago, spoke on vision analysis and orthoptics before the Hawaiian Optometric Association, Honolulu, February 18-19. He will also conduct a contact lens seminar while in Hawaii.

TRANSACTIONS OF THE AMERICAN ACADEMY OF OPTOMETRY

A department devoted to announcements, reports, appointments, organization data, news, professional problems and ideals, as these relate to the Academy.

COMMITTEES AND ROSTER OF ACADMEY MEMBERS

Dr. R. W. Tubesing, president, American Academy of Optometry, has announced the appointment of the following Committees:

PAPERS AND PROGRAM COMMITTEE: Dr. Ralph E. Wick, Rapid City, South Dakota, chairman; Dr. Donald Springer, Anniston, Alabama, Dr. Paul L. Connolly, Royal Oak, Michigan.

SECTION ON ANISEIKONIA AND REFRACTIVE PROBLEMS: Dr. Oscar L. McCulloch, Holyoke, Massachusetts, chairman; Dr. Benton Freeman, Allentown, Pennsylvania; Dr. Robert E. Bannon, Southbridge, Massachusetts; Dr. Edwin W. Bechtold, Middle Village, New York; Dr. G. M. Belanger, Ottawa; Dr. Harold M. Fisher, New York City; Dr. William P. Schumann, Vineland, New Jersey.

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In this issue, pages 103-116, is also presented the Geographical Roster of Academy members. This roster is published annually in the February issue. Members and all of our more than 7,000 readers are urged to file this special issue for reference purposes as this geographical roster affords a basis for making qualified referral for those patients moving from one part of the world to another.

RUDOLPH EHRENBERG.

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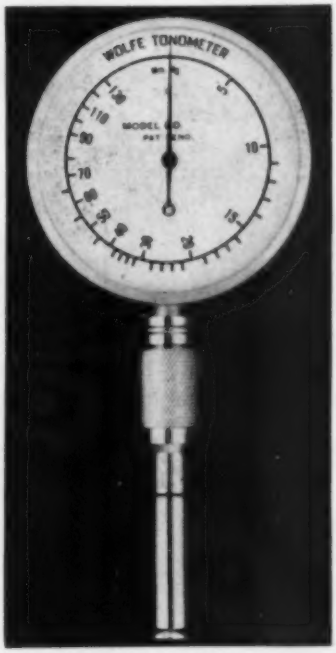

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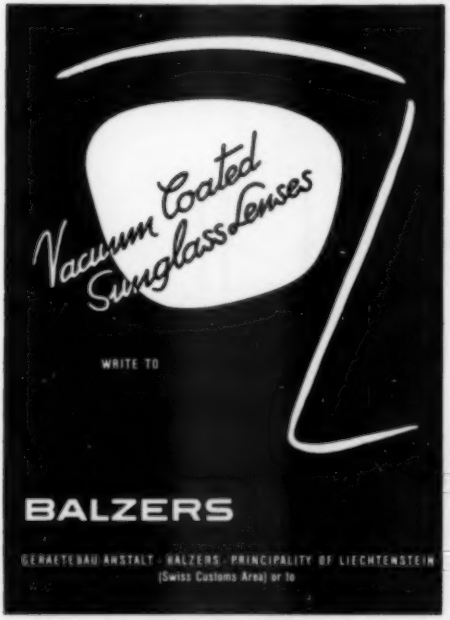
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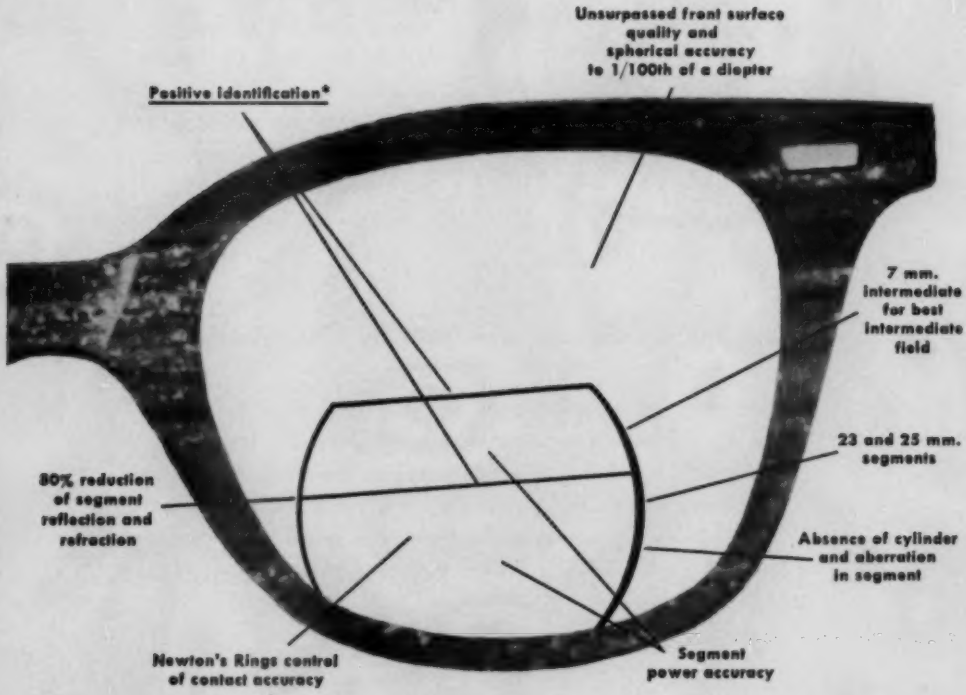
Univis Nu-Line 7CVs
T. M

What've they got that gets you...*ahead?*


Unsurpassed front surface quality and spherical accuracy to 1/100th of a diopter
Positive identification*
7 mm. intermediate for best intermediate field
23 and 25 mm. segments
80% reduction of segment reflection and refraction
Absence of cylinder and aberration in segment
Newton's Rings control of contact accuracy
Segment power accuracy

*Note the *identifying brown-pink line*

More Univis CV's being worn than all other 3-foci lenses combined

Your Warranty
This Rx has been filled with a genuine Univis Precision Lens as prescribed. Our exacting laboratory processing together with Univis superior performance provides you with the world's finest optical product.

Performance satisfaction guaranteed by

The UNIVIS LENS Company
Dayton 1, Ohio

Now... as always... corrected curves

Rx Orders come to DAL-TEX from around the World

Service...

No further away from you than the sound of the overhead plane . . . that's Dal-Tex! And as fast and reliable as the mailman who makes his daily rounds to your doors.

Trust and Confidence are built by Performance . . .

Guarding your professional reputation as carefully as we do our own, we painstakingly fill your Rx. Your standards mean but one thing at Dal-Tex — the best available ophthalmic materials — the finest workmanship. Dal-Tex' ever-growing reputation as a prime supply source for the profession is built on these fundamentals — *Savings — Service — Quality.*

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